LONG-TERM RESTORATION PROGRAM FOR THE HISTORICAL SOUTHWESTERN WILLOW FLYCATCHER (*Empidonax traillii extimus*) HABITAT ALONG THE LOWER COLORADO RIVER

WORKING DRAFT

Submitted by Lower Colorado Region, Bureau of Reclamation

WORKING DRAFT

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INTRODUCTION

On April 30, 1997, the U.S. Fish and Wildlife Service (Service) issued a Biological and Conference Opinion on the U.S. Bureau of Reclamation's (Reclamation) routine operations and maintenance of the Lower Colorado River from Lake Mead to the Southerly International Boundary between the United States and Mexico (USFWS, 1997) (Figure 1). In this opinion, the Service stated that Reclamation's proposed action for operation and maintenance of facilities on the Lower Colorado River is likely to jeopardize the continued existence of several species, including the endangered southwestern willow flycatcher (Empidonax traillii extimus). The Reasonable and Prudent Alternative (RPA) authored by the Service as part of this Biological Opinion, includes both short and long-term provisions for the recovery of the southwestern willow flycatcher along the lower Colorado River. Concurrently, a Multi-Species Conservation Program (MSCP), comprised of federal, state, and private organizations, has been initiated with the goal of producing and implementing a plan for the conservation of over 100 species along the Lower Colorado River over the next fifty years.

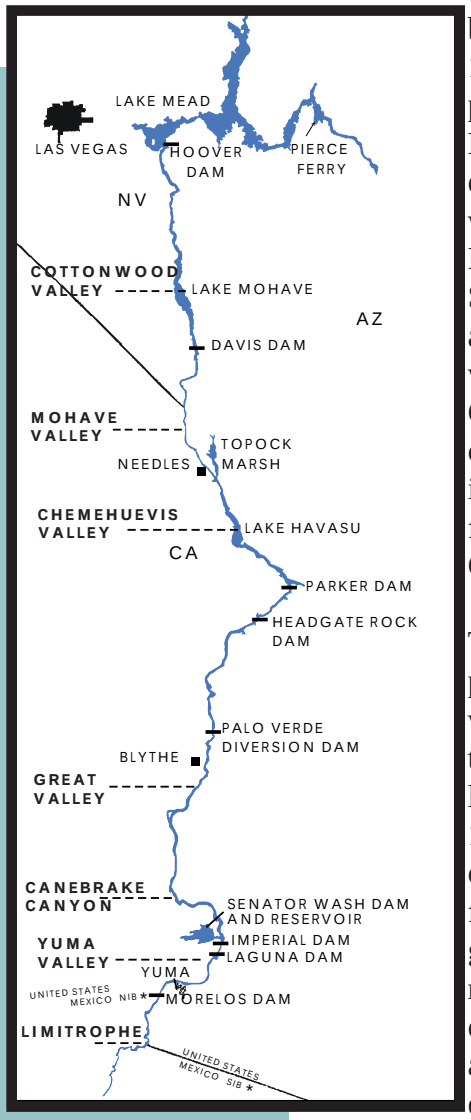

Figure 1. Map of the lower Colorado River.

Two provisions of the RPA deal with the short and long-term protection, enhancement, restoration, and acquisition of southwestern willow flycatcher habitat. RPA#5 directs Reclamation to protect, enhance, or restore 1400 acres of southwestern willow flycatcher breeding habitat by January 1, 2001 (USFWS, 1997) (Appendix A). Efforts are currently underway to identify occupied or potential habitat within the southwestern willow flycatcher breeding range where Reclamation can meet this goal. In order to meet RPA#11, Reclamation has submitted this report to the MSCP identifying the historical number of acres of *potentially suitable* southwestern willow flycatcher habitat and offering potential areas for the protection, restoration, enhancement, or acquisition of breeding habitat (USFWS, 1997) (Appendix A).

SPECIES DESCRIPTION AND LIFE REQUISITES

The willow flycatcher is one of ten species in the genus Empidonax found in North America. Empidonax flycatchers are renowned for their physical similarities and, thus, for the difficulty in identifying individuals in the field (Phillips et al., 1964; Peterson, 1990; Tibbitts et al., 1994). *Empidonax traillii* is further divided taxonomically into five subspecies (USFWS, 1997). The southwestern willow flycatcher (*E. t. extimus*), one of three subspecies found in the western United States, is a smallish bird measuring approximately 5.75

inches and weighing less than 0.5 ounces. It has a grayish-green back and wings, whitish throat, light olive-grey breast, and pale body. Two white wing bars are visible. The upper mandible is dark, the lower light. The most distinguishable taxonomic characteristic of willow flycatchers is the absent or faintly visible eye ring. Recognition of subspecies in the field is exceedingly difficult, if not impossible. Subspecies differentiation has been based on subtle differences in color and morphology, using museum specimens (Unitt, 1987; Unitt, 1997; McKernan and Braden, 1998).

The southwestern willow flycatcher is a neotropical migrant. All subspecies of willow flycatcher winter in Mexico, Central America, and possibly northern South America (Peterson, 1990; Tibbitts et al., 1994). The exact wintering grounds of the *E. t. extimus* are unknown, at this time (Sogge et al., 1997; Unitt, 1997). Southwestern willow flycatchers may begin to arrive in breeding territory as early as late April and may continue to be present until August (McKernan and Braden, 1998). Migration routes are not completely known but do include drainages where breeding populations have not been documented in Arizona (USFWS, 1997). Other subspecies, including *E. t. brewsteri* and *E. t. adastus*, probably utilize identical migration corridors.

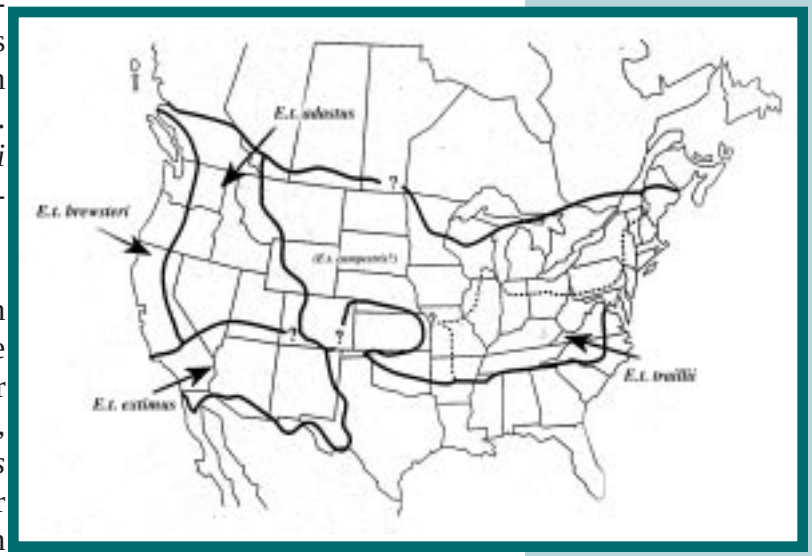

Figure 2. Approximate breeding ranges of the various races of willow flycatcher. Adapted from Unitt (1987), Browning (1993), and Tibbitts et al., 1994.

Southwestern willow flycatchers nest in riparian habitat characterized by a dense stand of intermediate sized shrubs or trees, such as willows (*Salix* sp.), *Baccharis*, buttonbush (*Cephalanthus* sp.), box elder (*Acer negundo*), or saltcedar (*Tamarix* sp.), often with an overstory of scattered large trees, such as cottonwoods (*Populus fremontii*) or willows. They may begin nesting in May and continue through July (Tibbitts et al., 1994; McKernan and Braden, 1998). Typically, southwestern willow flycatchers raise one brood per year but have been documented to produce more than one brood during a season (Whitfield, 1990; McKernan, per comm.). Brood parasitism by brown-headed cowbirds (*Molothrus ater*) has been documented throughout the range of the southwestern willow flycatcher and has been blamed for reducing flycatcher breeding success (Unitt, 1987; Brown, 1988; Rosenberg et al., 1991; Sogge et al., 1993; Muizieks et al., 1994; USFWS, 1997). Breeding territory for the southwestern willow flycatcher extends from extreme southern Utah and Nevada, through Arizona, New Mexico, southern California, and west Texas to extreme northern Baja California and Sonora, Mexico (Unitt, 1987) (Figure 2).

Description of breeding habitat

The southwestern willow flycatcher is a riparian obligate occurring in habitats characterized by dense stands of intermediate sized vegetation, usually with water

or moist soil present beneath the canopy. The Biological Opinion (USFWS, 1997) has identified five general habitat types utilized by nesting southwestern willow flycatchers range wide:

I) "monotypic, dense stands of willow (often *S. exigua* or *S. geyeriana* above 7000 feet in Arizona) 9 to 20 feet in height with no distinct overstory; difficult to penetrate; vertical foliage density uniformly high (>60%) from ground to canopy."

II) "monotypic, dense stands of saltcedar 12 to 35 feet in height forming a nearly continuous, closed canopy (i.e. no distinct overstory); vertical foliage density increases with height; canopy density uniformly high (approx. 90%); difficult to penetrate."

III) "dense stands of mostly Goodding's willow 12 to 40 feet in height characterized by trees of different size classes, a distinct overstory, subcanopy strata, fallen but living trees creating dense tangles difficult to penetrate."

IV) "dense mixtures of native broadleaf trees and shrubs including cottonwood, box elder, ash, buttonbush, and stinging nettle, characterized by a distinct overstory of cottonwood or willow with subcanopies and a dense understory of mixed species also difficult to penetrate."

V) "dense mixtures of native broadleaf trees and shrubs as in number 4 above mixed with exotics such as saltcedar or Russian olive primarily in the understory; dense ground-level tangles difficult to penetrate sometimes interspersed with small openings."

Other site characteristics may be important, however, most are poorly understood. Occupied patch size and shape can vary significantly, with areas as small as 0.6 hectares being utilized (M. Sogge, per. comm.). It appears, however, that linear habitats only one or two trees wide do not provide suitable nesting habitat for the southwestern willow flycatcher (USFWS, 1997). Other factors, including parasitism, predation, prey preferences and abundance, abiotic conditions (i.e. temperature, humidity), and population dynamics (i.e. site fidelity, distribution of breeding populations, dispersal, demography) are not fully understood and may affect breeding success. Studies are ongoing in an effort to further quantify habitat quality.

HISTORICAL HABITAT

RPA #11 states that Reclamation shall provide an estimate of historical acreage of southwestern willow flycatcher breeding habitat within the lower Colorado River floodplain from Lake Mead to the Southernly International Boundary. In order to accomplish this task, the lower Colorado River was divided into five reaches based on historical description (Figure 1):

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1) Grand Canyon to Cottonwood Valley

2) Mohave Valley to Mohave Canyon

3) Chemehuevis Valley

4) Great Valley of the Colorado

5) Canebreak Canyon to Mexico

The Colorado River, in its natural state, was a highly dynamic system. Flow rates and duration could change drastically from year to year with little or no correlation between successive years. Flow was seasonal and dependent on snow melt in the Rocky Mountains, mainly. Although flows have been recorded as high as 250,000 cubic feet per second at Yuma, years of catastrophic flooding appear to very rare (USGS, 1973; Stockton, 1975). A catastrophic flood event may be defined as an event which effects all aspects of the floodplain ecosystem for the entire length of the Lower Colorado River. More commonly, flows between 18 cfs and 250,000 cfs occurred (USGS, 1973). These flow regimes could effect a portion of the river but rarely disturbed the entire system. Sediment loading occurred in some areas causing degradation of the river channel, aggradation in other reaches, and the shifting of the river channel itself in still others. Riparian, marsh, and aquatic communities had to be adaptive.

The geomorphology of the river helped dictate where soil deposition, degradation and aggradation occurred. The Lower Colorado River is a series of narrow canyons interspersed with wide valleys. Water and sediment moved rapidly through the narrow canyons in all but the most dry years. These rapid, sediment-filled flows prevented the establishment of most riparian plant communities. Conversely, once the water and sediment was released from a narrow canyon into one of the broad valleys, soil deposition occurred. The rate of aggradation was dependent on flow rate and sediment loading. It was within these large valleys that the native plant communities became established. Sporadic large flows caused the river channel to migrate and created or reconnected oxbows and backwaters.

Chronology of development along the Lower Colorado River

Native American tribes have called the lower Colorado River home for centuries. The first European explorers were Spanish priests and military expeditions whose main goals were obtaining gold, silver, and land for Spain (Ohmart, 1982) (Table 1). Journals left by these early Spanish explorers mainly noted the things of concern to the explorers: the native inhabitants and natural resources of immediate use to the Spanish. From the discovery of the Colorado River in 1540 by Hernando de Alarcon until the acquisition of the

Table 1. Chronology of the exploration of the Lower Colorado River.

1540	Hernando de Alarcon discovered the Colorado River.
1701-02	Father Eusebio Francisco Kino made two expeditions to the Colorado River.
1744-51	Father Jacobo Sedelmayr traveled through the Colorado River region.
1774	Establishment of a mission at Yuma by Spanish priests.
1774-76	Father Francisco Garces and Captain Juan Bautista de Anza conducted a series of expeditions in the Colorado River region.
1781	Destruction of the mission at Yuma by Yuma Indians.
1826	James Ohio Pattie, an American trapper, explored the lower Colorado River. Pattie may have been the first American to see the Grand Canyon (Ohmart, 1982).
1846	The Mexican-American War began. The "Army of the West", under General Stephen Watts Kearny, conducted a military reconnaissance of the Southwest, including the lower Colorado River region.
1846-47	Lieutenant Colonel Philip St. George Cooke led an expedition to follow Kearny's force and open a road to California.
1848	Acquisition of the lower Colorado River by the United States at the conclusion of the Mexican-American War.
1850	Lieutenant George H. Derby, aboard the schooner "Invincible", explored the Colorado River from the Gulf of California to Camp Independence (Fort Yuma).
1851	Captain Lorenzo Sitgreaves led an expedition down the Bill Williams River to the Colorado.
1852	The first steamboat, the "Uncle Sam", traveled up the Colorado River to resupply Fort Yuma. This marks the beginning of the steamboat trade which would have profound effects on the mature stands of riparian vegetation along the river.
1853	Lieutenant Amiel Weeks Whipple was assigned the task of surveying a new railroad route along the 35th parallel to California.
1854	Gadsden Purchase consummated, extending U.S. territory south of the Gila River to the present international boundary with Mexico. Major William H. Emory was appointed the new Boundary Commissioner and began surveying the newly established boundary between the U.S. and Mexico.
1857	Lieutenant Joseph Christmas Ives, aboard the "Explorer", explored the Colorado River to the head of navigation, Black Canyon.
1860	Dr. J.G. Cooper arrived at Fort Mohave to study wildlife.
1862	Colorado River Gold Rush began after silver was discovered at Eldorado Canyon and gold was discovered at Laguna de la Paz in 1861.
1867	G.W. Gilmore traveled up the Colorado as far as Callville at the head of Black Canyon.
1869	John Wesley Powell explored the Colorado River to the Virgin River confluence.

Table 1. Chronology of the exploration of the Lower Colorado River continued.

1877	Southern Pacific Railroad completed over the Colorado River at Yuma. First diversion of water from the lower Colorado River by European settlers for irrigation in the Palo Verde Valley near Blythe, California.
1878	Francis Berton, a Swiss prospector, explored the Colorado River.
1883	Atlantic and Pacific railroad completed over the Colorado River at Needles, California. Combined with the Southern Pacific crossing at Yuma and declines in the mining industry, this marks the beginning of the end to the steamboat trade along the Colorado River (Lingenfelter, 1978).
1885	First documented improvements on the lower Colorado River. Lieutenant S.W. Roessler hired a barge and crew to improve navigation at Six Mile Rapids and Mohave Crossing (Smith, 1972).
1889	Vernon Bailey arrived at Fort Mohave to study wildlife.
1894	Edgar A. Mearns arrived at Yuma to study wildlife.
1895	Construction of Alamo Canal began at Yuma.
1901	Construction of Alamo (Imperial) Canal is completed enabling irrigation of 75,000 acres.
1902	Reclamation Act passed establishing U.S. Reclamatin Service. U.S. government began planning large scale irrigations projects (LaRue, 1916).
1905-07	Large flood events break temporary diversion structure at Alamo Canal creating the Salton Sea. 330,000 acres inundated, increasing political pressure to dam the Colorado River.
1909	Laguna Diversion Dam completed.
1910	Dr. Joseph Grinnell explored the lower Colorado River from Needles to Yuma.
1920	Tamarisk appears along the mainstem of the Colorado River (Ohmart et al., 1988).
1922	Colorado River Compact signed.
1935	Boulder Dam (now Hoover Dam) completed.

lower Colorado River by the United States after the Mexican-American War in 1848, European settlers had little effect on the native habitats found along the lower Colorado.

Although American fur trappers periodically trapped beaver along the lower Colorado River and its tributaries in the early 1800's, the first official exploration by the United States didn't occur until war with Mexico was declared in 1846. A military expedition, under the command of General Stephen Watts Kearny, conducted a military reconnaissance from Independence, Missouri to San Diego, including the lower Colorado River region. Extensive notes on topography, geography, climate, flora, and fauna were taken by William Hemsley Emory, an engineer on the expedition (Emory, 1848). A second expedition, under the command of Lieutenant Colonel Philip St. George Cooke, followed Kearny in 1847 to open a road to California. The notes taken by Cooke detailed a possible railroad route through what is now southern Arizona, prompting Congress to purchase the area south of the Gila River in the Gadsden Purchase of 1854 (Ohmart, 1982).

After the conclusion of the Mexican-American War and the annexation of the lower Colorado River region by the United States, several military expeditions were undertaken to evaluate the region for mineral wealth, navigable waterways, and overland routes (mainly railroad) to California. Several of these early explorers noted flora and fauna in their journals (United States War Department, 1852; Sitgreaves, 1853; White, 1858; Ives, 1861; Johnson, 1869; Adams, 1871). Many of these early descriptions were made more in passing. Expeditions whose main goal was to study the biotic community of the lower Colorado River ecosystem were uncommon in the 19th century and early 20th century, with the notable exceptions of Edgar A. Mearns work around Yuma in 1894 (Mearns, 1907) and the Joseph Grinnell led University of California expedition of 1910 (Grinnell, 1914).

Although several of the early explorers believed that the Colorado River had limited value (Ives, 1861), prospectors began to arrive by the mid-1800's. In 1861, silver was discovered at Eldorado Canyon and gold was found at Laguna de la Paz, creating the Colorado River Gold Rush of 1862 (Lingenfelter, 1978). The Gold Rush fueled the fledgling steamboat trade along the Colorado River. Initially, downed, dried mesquite, cottonwood, and willow were utilized as fuel by the steamboats (Ives, 1861). However, increased river traffic soon utilized all of the available wood debris so crews began cutting down large quantities of cottonwoods, willows, and mesquites. By 1890, most of the large cottonwood-willow stands and mesquite bosques had been cut over (Ohmart et al., 1988; Grinnell, 1914). Natural flood events still enabled regeneration to occur, however.

Major changes to the lower Colorado River ecosystem really began with the advent of large scale agriculture. European settlers first began diverting water from the Colorado River in 1877 to irrigate agricultural lands in the

Palo Verde Valley near Blythe, California. In 1885, the first documented instance of alteration of the lower Colorado River occurred when Lieutenant S.W. Roessler hired a barge and crew to make improvements at Six Mile Rapids and Mohave Crossing for navigational purposes (Smith, 1972). By 1901, water was being diverted for large scale agriculture in the Imperial Valley via the Alamo Canal at Yuma, Arizona (USBR, 1996).

In 1902, the United States Congress passed the Reclamation Act which established the U.S. Reclamation Service. The Reclamation Service began to plan large scale irrigation projects throughout the west, especially along the lower Colorado River (LaRue, 1916). Additional emphasis was placed on flood control along the lower Colorado River after the floods of 1905-7, which inundated over 330,000 acres and created the Salton Sea after breaching the diversion structure at the head of the Alamo Canal (Ohmart et al., 1988; USBR, 1996). The solution to the growing need for water, flood control, and power needs was to build a series of dams along the lower Colorado. The Laguna Diversion Dam was the first dam completed on the Colorado River in 1909. Water diverted from Laguna Dam and transported through the Yuma Main Canal irrigated 53,000 acres in the Yuma Valley and 14,700 acres in the Reservation Division in California. An additional 3,500 acres of agricultural land was irrigated from water diverted at Laguna Dam and transported to the Gila Valley via the North Gila Canal (USBR, 1996). The large sediment loads historically found in the Colorado River, estimated to average 160,000,000 tons passing Yuma annually (LaRue, 1916), caused Laguna Dam to silt in almost immediately. From 1913 to 1927, irrigated acreage almost doubled along the lower Colorado River, going from 53,000 acres to 95,000 acres (Wilber and Ely, 1948).

In 1918, Arthur P. Davis, Reclamation Director and chief engineer, proposed a dam of unprecedented height to be built in Black Canyon, between Nevada and Arizona, to control the Colorado River (USBR, 1985). In 1928, Congress passed the Boulder Canyon Project Act, authorizing the construction of Hoover Dam. Construction began with the diversion of the Colorado River around the damsite through two diversion tunnels on the Arizona side of the river in 1932. Two additional tunnels were constructed on the Nevada side by late 1933. Construction of Hoover Dam was completed on May 29, 1935.

Estimation of historical habitat

The construction of Hoover Dam caused large scale changes in the lower Colorado River ecosystem. Natural regeneration of native plant communities became limited with the elimination of annual flood events. Exotic plant species, such as the highly adaptive Tamarix sp., have become established and have proliferated with the change in the natural hydrograph. Fire has become a major force in succession of plant communities along the lower Colorado River. All of these factors have changed the availability and composition of southwestern willow flycatcher breeding habitat.

Estimation of historical southwestern willow flycatcher habitat was based primarily on interpretation of a series of aerial photographs taken by the Bureau of Reclamation in 1938. These photos provided coverage of the floodplain from Hoover Dam to the SIB, with the exception of the Chemehuevis Valley which was about to be inundated by Parker Dam. Old photographs and journals were also used to help define habitat. However, many of these photos and journals were observations made from the river itself and weren't always able to show a complete picture of the entire floodplain. Old surveyor plats were also used to help define habitat within the Chemehuevis Valley.

Table 2. Assumptions used to derive the estimate of historical habitat.

- 1938 aerial photos represent a snapshot of historical habitat that is not an extreme condition
- 1938 aerial photos are inclusive of all riparian habitat between the Grand Canyon and the SIB except::
  - Chemehuevis Valley where habitat estimates were derived from surveyor plats and the 1902 USGS topographic maps.
  - Yuma Valley where much of the historical habitat had been lost after completion of Laguna Dam.
- Habitat delineation from 1938 photos was inclusive rather than exclusive
- The closure of Hoover Dam in 1935 did not greatly influence the riparian habitat by 1938.
- Historical willow flycatcher breeding habitat was comprised of dense willows, often with an overstory of cottonwood.
- Natural stochastic events caused fluctuations in potential willow flycatcher breeding habitat

In order to estimate the amount of southwestern willow flycatcher habitat present prior to 1935, several assumptions were made(Table 2). Until the completion of Hoover Dam, the Colorado River ecosystem had changed very little, with the exception of some development in the Yuma Valley after the completion of Laguna Dam. While Hoover was being constructed from 1932 to 1935, the river was diverted in its entirety through diversion tunnels around the construction site. This diversion had no effect on the river ecosystem outside of Black Canyon.

The Colorado River ecosystem was a highly dynamic system historically (USGS, 1973; Stockton, 1975). For one to assume that the 1938 photos represent a snapshot of historical habitat that is not an extreme in one direction or another, one must look at historical flow data and other influences on the ecosystem in place by 1938. USGS streamflow data and estimated annual water flow from tree ring analysis and other methods indicate that the water years from 1901 through 1938 were wetter than average but not abnormal (Stockton, 1975; USGS, 1973; Arizona Daily Star, 1998). One can therefore assume that the 1938 photos give a snapshot look at what the river ecosystem was like historically. Any influence Hoover Dam had on the system by 1938 would be limited to small acreages of newly regenerated vegetation within the braided river channel itself that would normally be lost to subsequent floods. Although Tamarix began to appear along the lower Colorado in the 1920's, it's abundance was still somewhat limited by 1938 (Ohmart et al., 1988).

The second assumption made when estimating historical acreage related to what constituted willow flycatcher habitat historically. Willow flycatchers nest in dense vegetation from 8-25 feet in height. Historically, the nesting

strata was primarily comprised of willows, often with an overstory of cottonwoods present. In order to meet the time constraints presented in RPA#11 with the data and equipment available, Reclamation decided to delineate historical acreage from the 1938 photos somewhat liberally. Any stand that was comprised of willows and cottonwoods that was dense enough so that large patches of open ground could not be observed from the photos was delineated. Small open areas, up to 5-10 acres, were not delineated separately from large blocks of nesting habitat. These blocks were then digitized by computer to obtain the estimated number of historical acres. This method may have overestimated the number of historical acres by including open areas within the breeding habitat delineated but it is not unreasonable to assume that these areas had the potential to become nesting habitat at some future time.

Estimation of historical habitat from the Grand Canyon to Cottonwood Valley

Spanish missionaries and explorers first discovered the Grand Canyon and Lake Mead areas in the 1500's (Winship, 1933). These early expeditions, and those in subsequent years conducted by the Spanish, left little or no descriptive information on the native biota of this area. In 1858, the U.S. government sent Lieutenant James C. Ives up the Colorado River from the Gulf of California to ascertain the Colorado River's potential for navigation. Ives' stern wheeler, the "Explorer", ran aground at the south end of Black Canyon. As his crew repaired the damages to the "Explorer", Ives and several others of his party decided to explore Black Canyon by skiff. After several days of struggle against current, Ives concluded that Black Canyon was the limit to practical navigation along the Colorado River. Ives then proceeded overland with several of his party to the Grand Canyon. Ives seemed dutifully unimpressed with the Grand Canyon and the Colorado River stating that "Ours has been the first, and will doubtless be the last, party of whites to visit this profitless locality" (Ives, 1861).

Ives expedition provided the first written comments on the vegetation found within Cottonwood Valley (present day Lake Mohave). He wrote that "The Cottonwood Valley was found to be only five or six miles in length and completely hemmed in by wild-looking mountains. The belt of bottom land is narrow, and dotted with graceful clusters of stately cottonwood in full and brilliant leaf. The river flows sometimes through green meadows, bordered with purple and gold rushes, and then between high banks, where rich masses of foliage overhang the stream, and afford a cool and inviting shade" (Ives, 1861).

During the winter of 1857-58, James L. White ascended the Colorado River aboard the steamship "General Jessup" as far as Cottonwood Valley. He described Cottonwood Valley as being 10 miles long by 3 miles wide with a good growth of cottonwood "probably also contains willow and mesquite" (White, 1858).

In 1867, G.W. Gilmore ascended the Colorado from the Delta to Callville, near present day Callville Bay on Lake Mead, aboard the steamship "Esmeralda". Gilmore described the stretch between Mohave Valley and Cottonwood Valley as "The shores continue of low mesas on each side. There is very little timber to be seen....Cottonwood Island, about 10 miles long by an average of about three miles wide, is a fine, level island, fertile and covered with grass, and having considerable timber" . Gilmore further described the river from Cottonwood Island to Callville in the following way: "Leaving Black canon, the country again becomes open, with occasional bottom lands and grass on either side, up to Vegas Wash, six or eight miles distant....There is scarely any timber growing from Black canon to Callville...."(Browne, 1869).

Figure 3. The Colorado River as it emerges from the Grand Canyon, near present-day Pierce Ferry, Arizona (from Freeman, 1923).

In 1871, Captain Samuel Adams wrote a report to Congress on his explorations of the Colorado River. In this report, Adams states that for 30 miles downstream of Callville all the trees had been cut so that his steamboat was unable to acquire fuel (Adams, 1871).

The Grand Canyon itself was first successfully navigated by John Wesley Powell in 1869. Powell took few notes on the native biota on this trip or on a subsequent trip in 1871. In 1889-90, an expedition led by Robert Brewster Stanton recorded some natural history information and took numerous photographs of the Grand Canyon (Stanton, 1965). Stanton recorded that the Grand Canyon was basically devoid of vegetation due to the scouring flows it was subjected to each spring.

Figure 4. Rioville, Nevada (also known as Bonelli's Landing). It now lies as the bottom at the bottom of Lake Mead, formed behind Hoover Dam. Rioville was founded by Daniel Bonelli, a Mormon pioneer sent by Brigham Young, about 1865 at the mouth of the Virgin River.

Julius F. Stone accompanied a party down the Colorado from Green River City, Wyoming to Needles during the fall of 1909. Stone reported that vegetation was very sparse from Lee's Ferry to Black Canyon. Out of approximately 160 photos taken during this portion of the expedition, no photos showed vegetation in a large enough patch to provide willow flycatcher habitat (Stone, 1932).

Photographic evidence and journal accounts indicate that willow flycatcher habitat did not exist, or existed in very limited amounts, between Lee's Ferry and Cottonwood Valley (Figures 3 and 4). This is substantiated by the 1938 aerial photos that cover Black Canyon from Hoover Dam to Cottonwood Valley. From all accounts, Cottonwood Valley itself did contain a limited amount of habitat historically (Figure 5). Delineation of the 1938 aerial photos arrived at a figure of 2146 acres of potential habitat. From Cottonwood Valley south to Mohave Valley, willow flycatcher habitat became scarce once again.

Estimation of historical habitat from Mohave Valley to Mohave Canyon

As with the Cottonwood Valley - Grand Canyon area, the first written descriptions of the Mohave Valley came from U. S. Military expeditions. In 1854, a survey crew, under the command of Lieutenant Amiel Whipple, explored the Colorado in search of a railroad route to California. Whipple passed through the Mohave Valley during the late winter of 1854 and noted that "the soil, for miles from the river, seemed of exceeding fertility" (Whipple, 1856). During the winter of 1858, Lieutenant Joseph Ives entered the Mohave Valley on his expedition to uncover the navigational possibilities of the Colorado River. Ives noted that there was "plenty of timber in the valley" (Ives, 1861). James White, aboard the "General Jessup" in 1857-58, commented that the Mohave Valley was 60 miles long and 10-15 miles wide, with little timber in the lower half but in the upper half, timber was "quite plentiful" (White, 1858).

In late 1860, Dr. J. G. Cooper arrived in the Mohave Valley to study the wildlife found along the Colorado River. Dr. Cooper described the Valley as being about 10 miles wide and consisting mainly of uplands, with a narrow river bottom, not over a mile in width, that "supports a vigorous growth of cottonwoods, willows, and mesquite" (Cooper, 1869).

Figure 5. Cottonwood Valley, circa 1890. This area now lies under Lake Mohave (USGS photo in National Archives, from Ohmart, 1982).

G. W. Gilmore described the Mohave Valley as "differing little in character until reaching Fort Mohave, about 30 miles above. For this distance the bottom lands prevail, bordered in the distance by the mesa, which occasionally comes up and skirts the river for short distances and then again recedes, leaving long, wide stretches of low lands covered with vegetation, and producing the same timber as that found lower down the river...." (Browne, 1869).

Figure 6. Mohave Valley, 1922, near present-day Bullhead City, Arizona (from Freeman, 1023).

In an 1870 report to the U.S. Surgeon General, an assistant surgeon stationed at Fort Mohave described the Mohave Valley as "The plateau extends north and south about 40 miles, with an average width of 10 or 12 miles. There are two reservations, each three miles square. The camp is built on the upper one. The lower reservation is on the low bottom land, about six miles south of the post. Part of it is subject to overflow; the soil is fertile, and is covered with coarse grass, cottonwood, and mesquite trees, with a dense undergrowth of willows and arrow-weed. With this exception the country is a waste"(Stirling, 1870 quoted in Ohmart, 1982).

In the spring of 1889, Vernon Bailey arrived at Fort Mohave to study and collect flora and fauna. He described the Colorado River in the Mohave Valley as "These [river] flats are one to three miles wide and now about 6 feet above water. They are mostly flooded during high water and are traversed by a number of now dry channels, which in places have washed out deeper and contain water....Most of the flats are covered with thick brush and small timber, principally willow, cottonwood and mesquite" (Bailey, 1889 quoted in Ohmart, 1982). Bailey stated "From Pyramid Canyon, 13 miles north of Ft. Mohave, to Mohave Canyon, 12 miles below Needles, is a broad river valley 42 miles long with brushy and timbered flats near the river and dry, barren mesas' sloping back to low mountains on either side" (Bailey, 1889 quoted in Ohmart, 1982).

Figure 7. Mohave Canyon, 1910 (Photo by J. Grinnel, from Ohmart, 1982).

Mohave Canyon, the stretch of the river from the Needles extending south to the Chemehuevi Valley now known as Topock Gorge, appeared to have very little riparian vegetation. Most reports just mention passing through a canyon and entering Mohave Valley (Ives,1861; Browne, 1869). Bailey noted the lack of vegetation within the canyon (Bailey, 1889 quoted in Ohmart, 1982). Photographic evidence seems to back this hypothesis (Figure 7).

Journals and old photographs indicate that the Mohave Valley contained some willow flycatcher habitat, especially in the northern end of the valley near Fort Mohave (Figure 6). Flycatcher habitat appears to be limited to a narrow belt along the river north of Needles. The 1938 aerial photos show habitat present in non-contiguous patches along the entire valley with the majority of habitat found in the northern half. This would correspond with historical descriptions. The 1938 aerial photos indicate 12,610 acres of potential habitat.

Estimation of historical habitat within t he Chemehuevis Valley

The Bill Williams River flows into the Colorado River in the south end of the Chemehuevis Valley. Historically, the Bill Williams was a favorite overland route to the Colorado River. As one of only two major tributaries of the Colorado below Black Canyon, the Bill Williams River and the Chemehuevis Valley were mentioned prominently throughout historical journals as early as the 1700's. Father Jacobo Sedelmayr, a Jesuit missionary, noted in 1744 that the banks of the Colorado near the confluence of the Bill Williams River were "exceedingly high" (Dunne, 1955). In 1775, Father Francisco Garces came upon the Bill Williams - Colorado confluence and reported "I came to a river that I named the Rio de Santa Maria. Its bed is very wide, but at this time [August] it was only half full of water. Along its banks are pasturage and every sort of riverland tree...(Galvin, 1965).

In the early 1800's, American fur trappers began to appear in the Southwest.

According to Mexican law, it was illegal for foreigners to trap in Mexican territory. However, many trappers circumvented the law by becoming Mexican citizens, being granted special licenses on the condition of training Mexicans to trap, bribery, or evasiveness (Hafen, 1997). Trappers utilized both the Gila and Bill Williams River as travel corridors to the Colorado. Unfortunately, few trappers recorded their discoveries.

In 1851, a United States military expedition, lead by Captain Lorenzo Sitgreaves, followed the Bill Williams River to its confluence with the Colorado. S. W. Woodhouse, a member of the expedition, described the Bill Williams as "On the banks of this stream are growing willows of several kinds, one of which, affords good fodder for the mules; they oftentimes whilst on this stream had nothing else, and in fact we thought that we were doing well when we found this species of willow; also arrow-wood....and in some places grass."(Sitgreaves, 1853).

Figure 8. Chemehuevis Valley, 1910 (from Grinnell, 1914).

Lieutenant Amiel Whipple's survey party traveled down the Bill Williams River to the Colorado in 1853 on its way to Los Angeles. In February, 1853, Whipple's party reached the confluence where Whipple recorded "The Colorado came from the northwest, meandering a magnificent valley, and having received the waters of the Bill Williams' fork, entered a chasm among a pile of black mountains below....The Bill Williams' fork, at the junction, is twenty-five feet wide, and two feet deep....The [Colorado River] is here about two hundred and fifty yards wide, with a current of probably three and a half miles per hour. Above, it appeared wider, deeper, and less rapid. On both banks are strips of bottom lands, from a half mile to a mile wide. The soil is alluvial, and seems to contain less sand and more loam than is found in the valley of the Rio del Notre. But here, as there, are occasionally spots white with efflorescent salts. A coarse grass grows luxuriantly upon the bottoms. Bordering the river are cotton-woods, willows, and mezquites, or tornillas, but more sparsely scattered than in the watered part of the valley of Bill Williams' fork" (Whipple, 1856).

In 1858, Lieutenant Joseph Ives' expedition passed the confluence of the Bill Williams and the Colorado on their way to find the head of navigation along the Colorado River. Ives, who had accompanied Whipple during the 1853 expedition, had difficulty finding the mouth of the Bill Williams. Ives wrote in his report to Congress "I now looked in vain for the creek. The outline of the bank, though low, appeared unbroken, and for a while I was quite confounded. My companions were of the opinion that I made a great topographical blunder, but I asked Captain Robinson to head for the left shore, proposing to camp and make an examination. As we approached the bank I perceived....a small dent, and after landing repaired to the spot, and found a very narrow gully, through which a feeble stream was trickling, and this was all that

was left of the Bill William's Fork. The former mouth is now filled up, and overgrown with tickets of willow." (Ives, 1861).

The next year, James White (1858) passed through the Chemehuevis Valley aboard the steamship "General Jessup". White noted that the Chemehuevis Valley was a narrow valley with a "considerable portion" of cottonwood, willow, and mesquite extending 12 miles long and 4 to 8 miles in width.

In 1878, Francis Berton, a native of Switzerland who had come to America to prospect for gold, described the Bill Williams - Colorado River confluence in the following way: "Its banks are covered with mesquite trees, willows and cottonwoods....The Bill Williams' valley is verypleasant; everywhere there are handsome cottonwoods and forests of willows and mesquite" (Berton, 1878; Rudkin, 1953).

In 1889, naturalist Vernon Bailey described the Chemehuevis Valley: "From Mohave Canon the valley widens with brush and cottonwood timber on the flats, until nearing Aubrey - at the mouth of the Bill Williams Fork." (Bailey, 1889 quoted in Ohmart, 1982).

The 1938 aerial photographs of the lower Colorado River did not include the Chemehuevis Valley. Parker Dam was nearing completion at this time and the Chemehuevis Valley was about to be inundated so, apparently, photos of this area were not deemed necessary. In order to estimate historical willow flycatcher habitat, the original surveyor plats of this area, compiled from 1915-16, were analyzed and overlaid on a series of topographic maps from 1902-03 (USBLM, unpub. data; USGS, 1927). Conclusions drawn from the surveyor notes, topographic maps, historical descriptions, and old photos (Figure 8) show that potential willow flycatcher habitat occurred in the northern portion of Chemehuevis Valley and around the confluence of the Colorado and the Bill Williams rivers. By overlaying the surveyor notes onto the topographic maps, an estimated 3500 acres of potential willow flycatcher habitat is believed to exist within the Chemehuevis Valley in the early 1900's.

Estimation of historical habitat within the "Great Valley of the Colorado"

From the confluence of the Bill Williams River, the Colorado River goes south through "a rough canon to pass through between Aubrey and Parker, just before entering the large valley that extends to Canebreak Canon" (Bailey, 1889 quoted in Ohmart, 1982). This is one of the few mentions of what is now known as the Parker Strip in the historical journals. From all indications, this canyon was similar to Black Canyon and Mohave Canyon to the north. The 1938 aerial photos show little, if any, willow flycatcher habitat within this stretch of the Colorado River.

The Great Valley of the Colorado, as named by Grinnell (1914) and undoubt-

edly countless others before him, extends from present day Parker, Arizona, to the head of Canebrake Canyon, just south of Cibola National Wildlife Refuge. The Great Valley is the most extensive bottom land area along the lower Colorado River north of Mexico. Early explorers often noted it's potential for agriculture (Browne, 1869; Smart, 1870 quoted in Ohmart, 1982; Rudkin, 1953).

Descriptions of the Great Valley varied. Ives (1861) stated in his report to Congress: "The scarcity of vegetation has been alluded to....The mineral wealth of this country somewhat atones for its animal and vegetable poverty, and in a geological point of view possesses a high degree of interest". Further up the valley, he records "Since leaving the Chocolate mountains we have traveled sixty five miles....There is a good deal of bottom land, and some of it is fertile; but much of it, as I am informed by Dr. Newberry, is so charged with alkali as to be unproductive....wherever there is bottom land, there is a thick growth of trees near the water, that intercepts the view of the country beyond. Large numbers of these trees are dead and sundried,
and furnish excellent fuel". In 1858, James White recorded the Great Valley as being about 145 miles long with cottonwood, willow, and mesquite in "great plenty" back as much as 15 to 20 miles from the river bank (White, 1858).

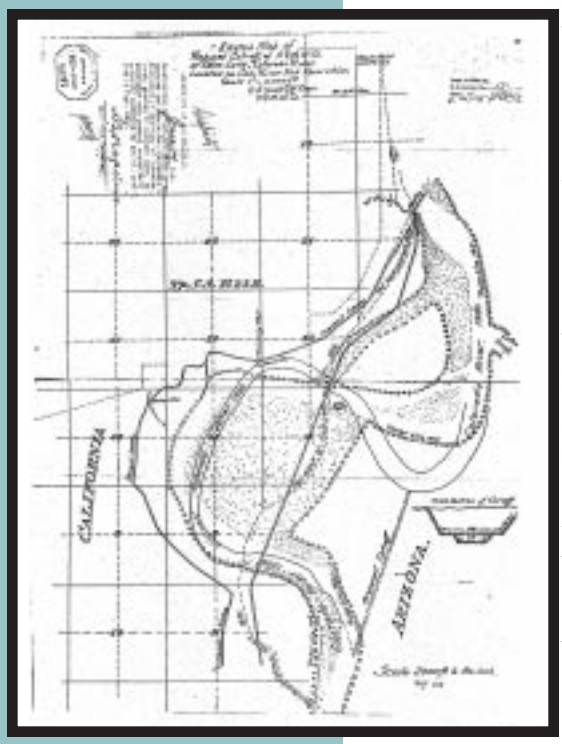
G.W. Gilmore, traveling aboard the steamship "Esmeralda", observed that "upon new lands formed by the cuttings of the river cottonwood, willow, and mesquite trees will be produced in three years large enough to cut for fuel. Fertile bottom lands extend with little interruption along the banks of the river from Fort Yuma to the Barriers—the first rapids on the river, situated about half-way to La Paz....The bottom lands prevail throughout the distance of 175 miles [Fort Yuma to La Paz], probably covering two-thirds of the way"(Browne, 1869).

Charles Smart, acting assistant surgeon at Camp Colorado (located 40 miles north of La Paz), noted the camp "is placed immediately on the river bank, above overflow, on the low level bottom, which is about 250 yards wide at this point....Some of the fertile bottom lands along the river are cultivated by the Indians. Cottonwood, mesquite, ironwood, willow, and arrow-wood grow along its banks" (Smart, 1870 quoted in Ohmart, 1982).

Berton described his first view of the Great Valley, as he passed Lighthouse Rock, this way: "Nothing ahead of us, to the horizon, but a plain cut by the willow and cottonwood bordered river"(Rudkin, 1953). As Berton proceeded up the Great Valley, he commented on the riparian vegetation he observed: "On the Arizona side we notice some fine cottonwoods behind which a rancho' a farm, called California Camp, 68 miles from Yuma....A fine grove of willows and cottonwoods separates the river from a little ridge, situated a few hundred yards behind it"(Rudkin, 1953). A few miles further upstream, he notes "The river is 1,600 or 1,800 feet wide...We pass a fine forest which stretches far into the distance; on the right a sandy plain, subject to flooding; in the distance a

line of willows and cottonwoods...There is some fine vegetation on the California side; on the other hand, everything is dry on the Arizona shore" (Rudkin, 1953). Berton continued to observe and comment on the cottonwood and willow growth along the river throughout the Great Valley. After weathering a sand storm and numerous sandbars within the river channel, Berton's party found itself about 100 miles from Yuma on April 13, 1878. Berton commented on seeing on the California side of the river "a dense forest of young trees as far as the eye can reach....This branch of the river and the cliffs, whose bases are bordered by a belt of bushy willows, remind me of the Arve near the forest of La Batie....I notice the scarcity of birds since our departure from Yuma...We are leaving the cliffs; the river bends to the left in a flat low region. On both sides there are bushes and forests of cottonwoods as far as the eye can reach"(Rudkin, 1953). Berton observed, 25 miles north of Ehrenberg, "an immense prairie covered with coarse swamp-like vegetation [arrowweed]....We see many mesquite trees....they grow more like bushes than trees...The prairie continues; there are fine vegetation and some fine woods...." (Rudkin, 1953).

Figure 9. Map of Olive Lake cut-off, near Blythe, California (Yost, 1920. Department of Archives and Manuscripts, Arizona State University).



Bailey described the Great Valley as he traveled south along the Colorado River to Yuma in the following way: "This valley, in which lies the Colorado River Indian Reservation, is about 140 miles long, and I should think in places 15 miles wide. The lowest part is mostly covered with cottonwood and willow timber and brush. The higher ground is open and sandy, with mesquite and creosote brush"(Bailey, 1889 quoted in Ohmart, 1982).

Grinnell (1914) observed the Great Valley and commented on the natural processes the river imposed on the valley and its flora. He noted that the river began to meander soon after exiting the canyon above present day Parker, with the meanders increasing in extent as the river flowed south through the valley. Grinnell observed the effects of the natural river migration and recorded: "The result [of the river meandering] is that in a short period of years, the major portion of the river's flood-bottom is worked over in the path of this irresistible and continual shifting of the channel. The effect on the flora is obvious. Only in the curves of the valley sheltered by abutting hills are trees given a chance to reach advanced age. The only trees capable of thriving on the unstable portion of the flood-bottom are such as grow rapidly, willows and cottonwoods....The observer, from any appropriate hill-top overlooking the valley, can readily discern the regularly graded heights of tree growth which mark the successive ages of the land on which they grow. The year-old seedlings but a few inches in height form a crescent-shaped belt along the inside of each curve of the river, facing down the valley. Paralleling this and next in position back from the river is dense two-year-old growth, succeeding which is a stand of still older growth. Because of the pro-

gressive trend of the process it is as a rule the oldest growth which becomes subject to the razing action of the river....”(Grinnell, 1914).

Grinnell also recorded the periodic occurrence of backwaters and sloughs cut off from the main river channel as the meandering occurred. He noted that these sloughs “are usually short-lived because of the rapid sedimentation at recurring times of general overflow. The bottom land immediately adjacent to the channel, where the latter is fixed for some time, is usually higher than the lateral tracts....At high water these lateral depressions are submerged to a depth of as much as twelve feet, as shown by actual measurement of the upper limit of mud marks on the tree trunks” (Grinnell, 1914). This phenomenon is observable today in places like the lower Grand Canyon.

Detailed maps showing historic vegetation are rare along the Colorado River. In 1920, C.E. Yost, chief engineer for the Palo Verde Metropolitan Water Company (?), sketched a map outlining a proposed cut-off at Olive Lake, near Blythe, California. Yost’s map (Figure 9) is interesting as it shows several historic river configurations, including the “Timber Line” as it occurred in 1915. It can be assumed, after reviewing aerial photographs of the area from the 1930’s, that Yost’s timber line corresponds to the cottonwood-willow community which gives an indication of the how far back from the river’s bank line this habitat may have extended in this area in 1915.

Figure 10. Ruins of the old city, Ehrenverg, Arizona on the Colorado River near west of Quartzsite, Arizona on U.S. 60 (Arizona Historical Society).

In 1938, Reclamation issued a contract for aerial photography of the lower Colorado River. The 1938 flight acquired complete photo coverage of the Great Valley floodplain from Parker to Canebrake Canyon. Analysis of these photos showed 43,984 acres of potential willow flycatcher habitat within the Great Valley in 1938. Historical journals, maps, and photographs collaborate this estimate (Figure 10). Although agriculture had already become established within the valley by 1938, these areas were above the cottonwood-willow bottom lands due to the instability of the river at this time.

Estimation of historical habitat from Canebrake Canyon to Mexico

Figure 11. Canebrake Canyon (from Dellenbaugh, 1902).

As the Colorado River exits the Great Valley, it flows through a canyon known historically as Canebrake or Canebreak Canyon (Figure 11). The stretch of the river from Canebrake Canyon to Explorers Pass, at the head of Yuma Valley, differed geomorphologically from the canyons upstream of the Great Valley. While many stretches of Canebrake Canyon area were narrow, with limited vegetation as was the Grand Canyon,

Black Canyon, Mohave Canyon, and the Parker Strip, there were several small valleys within this stretch that allowed for vegetation to become established, if only for short periods of time.

In 1858, Lieutenant Joseph Ives and his party traveled through Canebrake canyon on their expedition to find the head of navigation on the Colorado River. Ives recorded "The country through which we have passed is quite destitute of vegetation. Closer to the river is an occasional growth of mezquite, cottonwood, or willow, which furnishes abundant materials for fuel; but the hills are bare, and gravelly beds of the valleys sustain only desert shrubs" (Ives, 1861). Ives also noted that the banks of the river were lined with a thick growth of reeds that overhung the water.

Berton, in 1878, traveled through the Canebrake Canyon area and left the following descriptions: "At dawn we go on again up the river [from the Yuma Valley], which is narrowing perceptibly....The California shore is covered with mesquite and reeds called arrow-points', but the mountain behind is completely bare of vegetation....The river widens out again, and we are crossing a small plain....The plain is disappearing and we are entering a canon (gorge), where the river narrows and becomes more rapid. On each side there is a screen of bushes and reeds....We reach Castle Dome landing, 35 miles from Yuma....On the California side one sees only white sand, without any vegetation....there are tufts of bushes and some cacti on the Arizona side, which is higher. Farther on the river divides into two branches which enclose a little island covered with shrubbery and fine cottonwoods....We are coming to "Chimney Pick Canon", 45 miles from Yuma....I see only cactus and reeds....We are 50 miles from Yuma....The place is rather pretty; there are many willows and some cottonwoods....(Rudkin, 1953).

Bailey passed through Canebrake Canon, in 1889, on his way to Yuma. He observed that "Canebreak canyon is about 50 miles above Yuma where the river cuts through the last range of mountains before reaching the Gulf. The mountains are low, rough, perfectly bare rock. The river through the canon is rather straight, with low rocky banks and fringed most of the way with a dense hedge of reed - Phragmites communis, I suppose - which occupy all the soil at the water's edge and hang over the tops of the lower ones in the water" (Bailey, 1889 quoted in Ohmart, 1982).

Once the Colorado River exits the last of the canyons at Explorers Pass, it enters another large alluvial floodplain named the Yuma Valley. The Gila River, the Colorado's second major tributary below Black Canyon, enters the Colorado within the Yuma Valley. This major landmark is mentioned repeatedly in historical journals since the Spanish explorations. In 1774, Spanish missionaries established a mission at the confluence of the Colorado and Gila rivers, at present day Yuma, Arizona. An uprising by the Yuma Indians, in 1781, led to the destruction of the mission (Ohmart et al., 1988). In 1850, after war with Mexico, the United States established a military post at the

confluence named Camp Independence, which was later renamed Fort Yuma.

Early Spanish explorers noted the Yuma Valley, especially the Gila - Colorado confluence, in their journals. Father Jacobo Sedelmayr passed through the Yuma Valley in 1744 and described the confluence area as having a "rich growth of trees, with an expanse of pasture land in the depression of the river, and with the variety of trees which clustered along the water's edge" (Dunne, 1955). From 1774 through 1776, Captain Juan Bautista de Anza conducted several expeditions along the Colorado River in conjunction with several Franciscan missionaries. In December, 1775, during his second expedition, Anza described the area just south of Pilot Knob as "impenetrable tickets of various kinds of trees and brush" (Bolton, 1930). In the following May, Anza recorded that the Colorado River at the confluence with the Gila was impossible to ford "because of the great marshes encountered before reaching it and after entering it, to which are added very dense thickets" (Bolton, 1930). Father Pedro Font accompanied Captain Anza on his second expedition and described the difficulty in traveling the area around Pilot Knob: "The road, although nearly all level, was very difficult, because it was so thick with brush that in many places not more than a little trail was to be seen, the rest being densely grown with mesquite, tornilla [screwbean mesquite], and thickets of a shrub which they call cachanilla [arrowweed]" (Bolton, 1930).

In the early part of the 19th Century, the Gila River became a major travel corridor for American fur trappers to reach the Colorado River. In 1826, James Pattie, possibly the first American to see the Grand Canyon (Ohmart, 1982), described the Colorado River near its confluence with the Gila as "between two and three hundred yards wide, a deep, bold stream, and the water at this point entirely clear. The bottoms are a mile in general width, with exceedingly high, barren cliffs. The timber of the bottoms is very heavy, and the grass rank and high. Near the river are many small lakes, which abound in beavers" (Thwaites, 1905). Later that year, Pattie described the Colorado below its confluence with the Gila as "2 to 300 yards wide, with high banks that have dilapidated by falling in. Its course is west, and its timber chiefly cotton-wood, which in the bottoms is lofty and thick set. The bottoms are six to ten miles wide" (Thwaites, 1905).

In 1846, the United States sent a military expedition under General Stephen Kearny to explore the Colorado River region. William Hemsley Emory, an engineer with Kearny's force, described the Colorado River in the vicinity of the Gila-Colorado junction as being "perfectly straight, and about 600 feet wide" (Emory, 1848). He stated: "We traveled over a sandy plain a few miles, and descended into the wide bed of the Colorado, overgrown thickly with mezquite, willow, and cotton-wood; after making about ten miles, we encamped abreast of the ford on a plateau covered with young willows....(Emory, 1848). Emory describes the ford as "narrow and circuitous, and a few feet to the right of left sets a horse afloat.....The growth on the river bottom is cotton-wood, willow of different kinds, Equisetum hymale (scouring

rush), and a nutritious grass in small quantities" (Emory, 1848). Captain A.R. Johnson, another member of Kearny's party, described the same march: "...marched about ten miles to the river, and encamped on the sand bar, the willows being about 10 feet high and thick, with a good deal of grass mixed in their roots; the river is perhaps one third of a mile wide....the bottom, on the river here is about ten miles wide,and much of the land could bear cultivation; it is all now overgrown with almost impenetrable thickets of willows, mesquite, and Fremontia [cottonwood]...." (Emory, 1848).

Figure 12. The confluence of the Colorado and Gila Rivers (from Dellenbaugh, 1902).

In 1850, John R. Bartlett was appointed Boundary Commissioner and tasked to survey the newly established boundary between the United States and Mexico. Bartlett described the Colorado River as it wound through the Yuma Valley: "The Colorado flows through a bottom or valley from two to four miles in width, thickly covered with cotton-wood and mezquit; beyond which is the desert....I should think that the bottom-land of the Gila was from three to four miles wide near the junction. The portion towards the river is thickly covered with cotton-wood, and with willows on the margin, while further back has nothing but mezquit" (Bartlett, 1854).

Figure 13. Yuma, 1916 (from the Forbes Collection, Arizona Historical Society, Tucson, Arizona).

Several other travelers published reports which contained references to the Yuma Valley. A. B. Clark recorded that one and a half miles below the confluence the Colorado was "a thick growth of willows and cottonwoods, filled up with canes, vines, and weeds along the bank, through which it is difficult to penetrate. Farther back are clusters of mesquite..." (Clarke, 1852). In 1853, William P. Blake noted that "Our course, at first, lay over the bottom-lands of the Colorado, among cottonwoods, willows, and clumps of mezquite trees" from Fort Yuma to the mountains north of Pilot Knob (Blake, 1857). In 1875, J.V. Lauderdale and G. S. Rose, assistant surgeons, described the area around Fort Yuma: "The bottom land surrounding the fort and forming the right bank of the river, is covered with a heavy growth of arrow-weed, mesquite, and willow, and is intersected by a number of sloughs and lagoons, former beds of the river" (Lauderdale and Rose, 1875 quoted by Ohmart, 1982). In 1878, Berton described Fort Yuma: "It overlooks the desert and the banks of the Colorado, which are covered with vegetation. The lowlands are full of cottonwood and mesquite....(Rudkin, 1953). As he traveled up the Colorado through the Yuma Valley, Berton noted "The river banks are covered with cottonwoods and mesquite, the country is flat; the desert begins a half-mile from the river on both sides" (Rudkin, 1953). Vernon Bailey described the Yuma Valley in 1889: "From the town southward the valley, or river flats, widens out and seems to stretch away to the Gulf in a broad level

Figure 14. Laguna Dam site, 1908 (from the Forbes Collection, Arizona Historical Society, Tucson, Arizona).

tract of country but 10 to 15 feet higher than the river. A belt of cottonwood and willow timber extends at least 10 miles below on the west side of the river. The flats on the east side and farther back on the west are mostly covered with small saline shrubs, creosote bush, and mesquite trees....” (Bailey, 1889 quoted in Ohmart, 1982).

In 1894, Edgar A. Mearns traveled to the Yuma area to study mammals. He describes the general vegetation pattern of the lower Colorado River: “The river channel is marked by a line of unusually tall cottonwoods and a lesser fringe of willows (Salix fluviatilis). The adjacent bottom lands are covered more or less with mesquite and tornillo....The common shrubbery is a dense and monotonous growth of arrowwood (Pluchea sericea) and, in places, of Baccharis” (Mearns, 1907). Mearns described Yuma similarly: This station is on the left (east) bank of the Colorado River, at the mouth of the Gila. The channels of the Gila and Colorado rivers are marked by lines of tall cottonwood and a lesser fringe of willows. The adjacent bottom lands, which are broad and subject to annual overflow from the river, are more or less covered with mistle-toe matted mesquites and screwbeans....the commonest shrubs of the low ground are the arrowwood and Baccharis. As a result of an investigation along the Colorado River, made in January, 1902, by the hydrographic branch of the U.S. Geological Survey, the extent of the alluvial bottom land between Camp Mohave and Yuma was found to be from 400,000 to 500,000 acres” (Mearns, 1907).

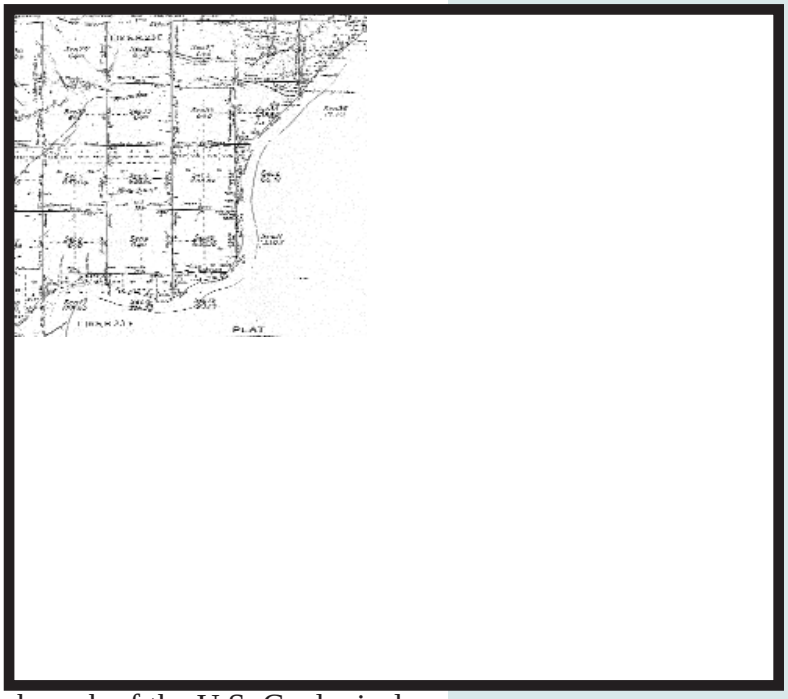


Figure 15. Map of Bard, California, area, circa 1900 (USGS, 1900. Department of Archives and Manuscripts, Arizona State University).

Grinnell (1914) noted that Laguna Dam, which was built at the head of the Yuma Valley in 1909, had a “pronounced modifying influence on the flora and fauna of the vicinity” (Grinnell, 1914). Grinnell observed that the existing riparian vegetation above the dam had been lost to inundation and that arrowweed had colonized the mudflats created by the heavy silt deposition above the dam. Grinnell also noted the changes to the ecosystem below the dam. He observed an increase in scouring below Laguna Dam that helped create a seven foot drop in the river channel which affected riparian vegetation. Grinnell states: “Thus the former flood-bottom was, in 1910, far above flood level, and in a way to become good second bottom, with appropriate metamorphosis in vegetation and fauna. Although these changes were local, and due to man’s interference, similar ones, due to natural causes, have doubtless occurred from time to time in various parts of its course in the river’s history, thus repeatedly shifting the riparian strips both in position and total width....(Grinnell, 1914).

The completion of Laguna Dam enabled large-scale agriculture to become established in the Yuma Valley. By 1938, when the aerial photos were taken, portions of the valley that may have contained willow flycatcher habitat historically, were being farmed. Analysis of the 1938 photos indicated approximately 11,136 acres of potential willow flycatcher habitat from Canebrake Canyon to Yuma. Analysis of historical journals, photographs, and old maps indicate that an additional 9,000 acres of potential habitat may have been present prior to Laguna Dam(Figures 12,13, and 14). General descriptions of vegetation composition were used in conjunction with the 1902-03 topographic maps of the river and a turn of the century USGS map of Bard to help in this estimation (Figure 15).

The 1938 aerial photos also showed an additional 3827 acres south of Yuma, along both sides of the river, to the Southerly International Boundary. This area, known now as the Limitrophe, was also under the plow by 1938. After reviewing the historical descriptions and old photographs, an additional 3,000 acres were added to the total digitized from the 1938 aerial photos. This figure represents an estimate of the amount of cottonwood-willow habitat lost adjacent to the mainstem of the Colorado River and surrounding backwater areas present on the aerial photos to agricultural encroachment by 1938.

Summary of estimation of historical habitat

Since the Colorado River was such a dynamic system historically, one can assume that the amount of southwestern willow flycatcher breeding habitat varied through time in correlation with historical flow. Journal excerpts often describe varying conditions along the lower Colorado River. In order to fully define historical habitat, one must describe the potential range in historical acreage.

Table 3. Estimate of historical habitat, by river reach, as delineated from the 1938 aerial photography (with appropriate adjustments)

River Reach	1938 Digitized Acres	Adjustments	Totals
Cottonwood Valley	2146		2146
Mohave Valley	12610		12610
Chemehuevis Valley		3500	3500
Great Valley	43984		43984
Yuma Valley*	11136	9000	20136
Limitrophe**	3827	3000	6827
Totals	73703	15500	89203

*Yuma Valley includes Canebrake Canyon
**Limitrophe Digitized acres include both the U.S. and Mexico sides of the river

Analysis of the 1938 aerial photos, including the adjustments for agriculture present by that time and the lack of coverage within the Chemehuevi Valley, show an aggregate total of approximately 89,200 acres of potential willow flycatcher breeding habitat from the southern end of the Grand Canyon to the Southerly International Boundary (Table 3). This number is likely on the high end of the historical scale for the following reasons:

1) Descriptions of the lower Colorado River generally agree with Grinnell's explanation of the processes involved within the Great Valley (Figure 16) (Grinnell, 1914). However, many of the early descriptions failed to differentiate between cottonwood, willow, and mesquite habitats. At first glance, one might assume that the early explorers didn't feel the need to differentiate between the "trees" but after reviewing surveyor plats (Figure 17), it becomes obvious that these species often grew in mixed stands or in clumps within other vegetation types (USBR, 1996; Ohmart et al., 1977). Analysis of the 1938 aerial photographs reveal the same tendency. In the analysis of the 1938 aerial photos, many clumps of non-flycatcher habitat (mesquite, arrowweed, areas of scattered density, etc.) were included within the general boundaries delineated simply because they were too small to delineate separately or because the quality of the 1938 photos made typing small clumps extremely difficult.

Figure 16. Profile of a section of the lower Colorado River (from Grinnell, 1914).

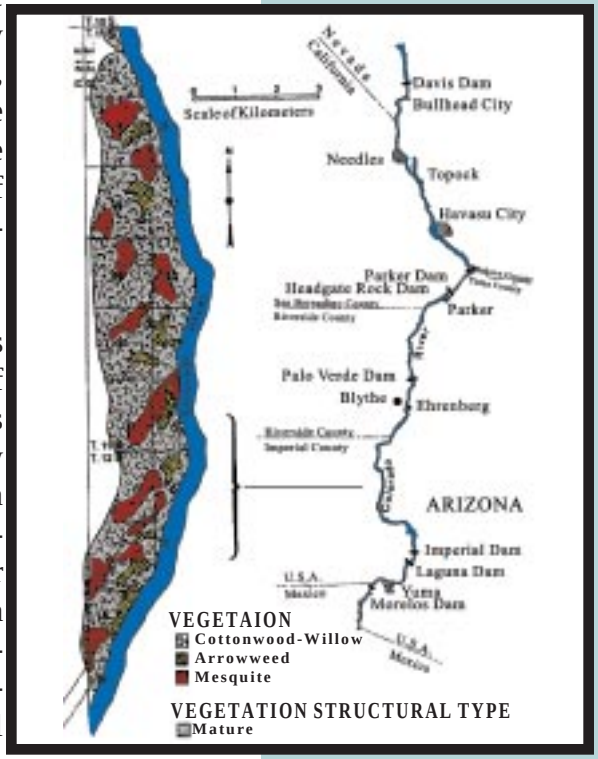


Figure 17. Vegetation communities, derived from surveyor plats, along a section of the Colorado River near Blythe, California, 1879 (from Ohmart et al., 1977).

2) Analysis of data derived from tree rings and clam shells by the University of Arizona have given an estimate of water flow on the Colorado River over the last 450 years (Stockton, 1975; Arizona Daily Star, 1998). USGS flow data indicates that the years from 1900 to the completion of Hoover Dam in 1935 were generally wetter than average (USGS, 1973). Disturbance caused by the higher flows created conditions more suitable for southwestern willow flycatcher by providing areas of moist, bare mineral soil needed for willow germination. Historically, southwestern willow flycatchers utilized early successional stands of willow for breeding habitat.

3) By 1938, man had disturbed the natural ecosystem for almost one hundred years. The demand for fuel by the steamboat trade had eliminated most of the mature cottonwood-willow gallery forests south of the Grand Canyon (Grinnell, 1914; Ohmart et al., 1988; Lingenfelter, 1978). These stands were often still cottonwood and willow but at an earlier successional stage that was even more attractive to the willow flycatcher. The construction of Laguna Dam had enabled large scale agriculture to develop within portions of the floodplain that may have historically contained willow flycatcher breeding habitat but that has already been factored into the total estimate.

4) Hoover Dam was completed in 1935, three years before the aerial photos were taken. Initially, Hoover may have provided more willow flycatcher habitat due to cessation of natural flood events over those three years. Sandbars, where willows germinated historically, were often lost to the next flood event, especially if that flood event occurred the subsequent year (USBR, unpub. data). Riparian vegetation also became established, admittedly in small

amounts by 1938, within the narrow canyons where historically little or no riparian vegetation existed due to the frequent scouring flood events (Webb, 1996).

It is difficult to come up with an actual acre number for the range limits around the 1938 total acreage figure. At best guess, the liberal interpretation of the 1938 photos may have overestimated the actual potential habitat by as much as 10-15%. The increase in habitat due to Hoover Dam was marginal. In 1930, Reclamation flew a portion of the Great Valley. When comparing these photos to the 1938 photos of the same area, there was an increase of approximately 2000 acres in 1938 (5%). Interpretive error could be as much a factor in this difference as an actual increase in habitat. Other factors, such as the wet cycle the Colorado River appeared to be in during the early 1900's, also must be factored in. Best estimate for the range of potential historical southwestern willow flycatcher breeding habitat along the lower Colorado River is 50,000-100,000 acres. This estimate takes into account both errors in interpretation of the 1938 photographs and stochastic factors such as the highly dynamic flow regimes found historically along the lower Colorado River.

Table 4. 1996-98 occupied southwestern willow flycatcher breeding habitat by river reach.

River Reach	Occupied Habitat
Grand Canyon to Davis Dam*	1146
Mohave Valley	2487
Mohave Canyon	66
Chemehuevis Valley**	838
Great Valley	126
Yuma Valley***	1373
Limitrophe	9
Totals	6045

*Grand Canyon to Davis Dam total includes lower Virgin River sites, lower Grand Canyon sites
**Chemehuevis Valley total includes lower Bill Williams River sites
***Yuma Valley total includes Canebrake Canyon

CURRENT OCCUPIED AND POTENTIAL HABITAT

Until recently, the southwestern willow flycatcher was considered extirpated from the lower Colorado River (Hunter et al., 1987; Rosenberg et al., 1991). In 1995, however, biologists at Havasu National Wildlife Refuge, near Needles, California, observed two fledgling willow flycatchers which prompted Reclamation to initiate comprehensive surveys in the spring of 1996 (Spencer et al., 1996, Christy Smith, per. comm.). Since 1996, nesting willow flycatchers have been observed from the Grand Canyon to the Limitrophe, south of Yuma (McKernan, 1997; McKernan and Braden, 1998; McKernan, per comm.). During the 1998 breeding season, approximately 61 pair of southwestern willow flycatchers were observed between Mesquite, Nevada on the Virgin River just above Lake Mead, to Gadsden, Arizona, south of Yuma. At least seven other individuals were observed throughout the breeding season, although breeding could not be confirmed for these individuals. Approximately 50 nests were discovered during the 1998 surveys (McKernan and Braden, per. comm.).

Southwestern willow flycatchers utilize saltcedar, primarily, for nesting substrate along the lower Colorado River. Often, there is also a small overstory

component of larger Gooddings willows. Occasionally, flycatchers are found within more historically typical breeding habitat but few stands of this type survive. Although the data are inconclusive, the two most important factors for flycatchers appear to be stand structure (density) and presence of water. However, stands that apparently have the necessary components to be utilized as breeding habitat by willow flycatchers are not always being used (McKernan and Braden, 1998). Some debate has been ongoing on whether saltcedar dominated stands act as sink habitats, furthering the decline of the species (Pulliam, 1988). Nest productivity studies along the lower Colorado River do not support this hypothesis (McKernan and Braden, 1998). Further studies are ongoing to try to answer these questions.

Table 5. 1994 acreage, by vegetation communities, along the lower Colorado River from Davis Dam to Mexico.

COMMUNITY TYPE	MOHAVE	TOPOCK GORGE	HAVASU	PARKER	PALO VERDE	CIBOLA	IMPERIAL	LAGUNA	YUMA	LIMITROPHE	TOTAL
SC I	278	0	0	0	0	0	0	0	12	0	290
SC II	6	0	2	2	0	0	47	5	9	16	87
SC III	67	13	0	0	27	23	67	15	40	15	267
SC IV	73,874	105	82	1,864	1,632	4,394	4,081	1,625	1,129	1,644	24,092
SC V	3,023	87	71	2,722	868	2,210	957	1,195	300	1,663	13,096
SC VI	1,429	16	85	1,598	1,111	322	517	552	239	1,142	7,011
CW I	0	0	32	0	2	0	0	0	0	34	68
CW II	26	0	0	26	0	90	6	3	0	0	151
CW III	644	0	335	8	3	64	278	38	318	145	1,833
CW IV	110	7	0	184	8	47	84	61	258	169	928
CW V	62	0	0	16	0	0	24	6	6	38	152
CW VI	13	0	0	2	33	0	2	28	27	161	266
HM III	41	0	0	0	0	0	0	0	0	0	41
HM IV	125	0	0	7	0	0	11	3	3	0	149
HM V	0	0	0	16	85	32	60	0	0	0	193
HM VI	6	0	0	0	0	0	18	0	0	0	24
SM I	3	0	0	0	0	0	0	0	0	0	3
SM II	14	0	0	0	0	0	0	1	0	0	15
SM III	500	0	0	0	1	0	0	0	7	0	508
SM IV	2,100	129	326	2,227	1,372	878	905	556	264	14	8,771
SM V	1,204	26	138	799	645	428	182	160	53	44	3,679
SM VI	300	0	31	376	589	65	9	195	0	0	1,565
SH III	4	0	0	0	10	0	53	0	0	0	67
SH IV	116	0	91	37	54	449	288	77	3	0	1,115
SH V	0	0	15	19	0	708	260	25	0	0	1,027
SH VI	0	0	3	0	0	128	0	0	0	0	131
AW VI	657	0	126	2,377	383	133	44	587	324	566	5,197
ATX VI	24	0	50	342	37	62	5	40	110	44	714
MA 1	1,450	420	474	69	8	380	823	524	55	13	4,216
MA 2	275	6	12	0	8	0	220	0	12	0	533
MA 3	164	30	59	321	19	71	922	249	76	2	1,913
MA 4	215	652	9	300	98	195	936	91	27	0	2,523
MA 5	84	95	16	13	5	26	65	9	1	0	314
MA 6	1	0	7	79	0	2	351	5	118	29	592
MA 7	420	8	7	69	22	30	74	31	126	144	931
CRV	0	106	223	0	0	0	151	113	153	3	749
TOTAL	20,747	1,699	2,195	13,474	7,022	10,738	11,440	6,196	3,821	5,887	83,218

[1] Community type codes: CW=Cottonwood-Willow, SC=Salt cedar, SH= Saltcedar-Honey mesquite, SM=Saltcedar-Screwbean mesquite, HM=Honey mesquite, AW=Arrowweed, ATX=Atriplex, MA=Marsh, CR=Creosote

Occupied habitat has been defined as "a contiguous area with consistent physical and biotic characteristics where territorial males or pairs of flycatchers have been documented during previous breeding seasons (generally after June 15 and before July 30...) at least once in the last few years, assuming the habitat had not been degraded or otherwise altered in the interim. If a portion of contiguous habitat is or was used, the entire contiguous area is considered occupied" (Cordery, per. comm.). Analysis of aerial photographs around survey sites which met this definition in 1996-98 estimate approximately 4093 acres of occupied habitat along the lower Colorado River from Pierce Ferry, Arizona to the SIB, not including an additional 806 acres along the lower Bill Williams River, an additional 966 acres along the lower Virgin River, and an additional 180 acres in the lower Grand Canyon. Occupied habitat along the lower Colorado, including these other areas of concern, total over 6045 acres (Table 4).

Suitable but unoccupied habitat is harder to define. If we assume that stand structure, stand density, and presence of water are the most important factors,

we can estimate potentially suitable nesting habitat by analyzing vegetation type maps. The Bureau of Reclamation has periodically compiled vegetation type maps of the lower Colorado River since 1976 (Anderson and Ohmart, 1976; Anderson and Ohmart, 1984; Younker and Anderson, 1986; Salas et al., 1996). The system currently used to classify vegetation along the lower Colorado River is based on plant community and structure (Anderson and Ohmart, 1984). Appendix B lists the habitat and structure types used in this system. Southwestern willow flycatchers seem to prefer stands with a component of dense vegetation between 8 and 25 feet in height (USFWS, 1997; Sogge et al., 1997). In the Anderson and Ohmart vegetation classification system, cottonwood-willow I, II, III, IV, V; Marsh types 2, 3, 4 (depending on surrounding vegetation); and saltcedar III would fit this criteria (Anderson and Ohmart, 1984). Some stands classified as saltcedar IV would also fit this criteria.

The most recently completed vegetation type maps were compiled from 1994 aerial photography. These maps cover the approximately 80% of the Colorado River floodplain between Davis Dam and the SIB. Some areas on the outer edges of the floodplain, farthest from the Colorado River itself, were not flown and, consequently, not mapped. A summary of vegetation type classes, by river reach, is shown in Table 5. Reclamation is currently revising the vegetation type maps using 1997 aerial photography. The revised maps will include the Grand Canyon from Separation Canyon down to Lake Mead, the Virgin River from the Virgin River Gorge to Lake Mead, and the shorelines of Lakes Mead and Mohave. Updated acreage numbers should be available in the spring of 1999.

1. Limitrophe
2. Below Colorado Gila Confluence
3. Imperial to Laguna Dam
4. Imperial NWR
5. Gilmore's Camp
6. Cibola NWR
7. PVIID lands
8. CRIT
9. Bill Williams River NWR
10. Planet Ranch
11. Havasu NWR

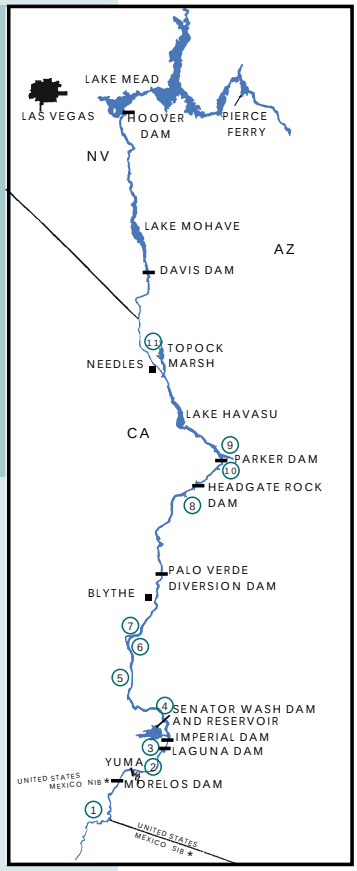


Figure 19. Map of potential restoration sites along the lower Colorado River.

Using the 1994 vegetation type maps, field reconnaissance was undertaken to analyze potential stands for habitat suitability. Young cottonwood-willow stands (types III, IV, and V) all require water to become established and to survive. Consequently, it can be assumed that these stands are potential willow flycatcher breeding sites. Cottonwood-willow types I and II stands could be remnants from the pre-dam period and must be analyzed for potential at this time. Saltcedar III stands have the stand structure needed to support breeding flycatchers but these stands must also be analyzed for proximity to water. Saltcedar IV stands need to analyzed for stand density and proximity to water to be included as suitable breeding sites.

Analysis of the 1994 vegetation type maps indicate approximately 11,197 acres of suitable but unoccupied habitat along the lower Colorado River (Table 6). The majority of both occupied and suitable but unoccupied habitat occurs within the Mohave Valley, near Topock Marsh, and in Canebrake Canyon, now usu-

Table 6. Occupied habitat and potentially suitable but unoccupied habitat by vegetation community type per river reach, 1998.

Community Type	Mohave Valley	Chemehuevis Valley	Great Valley	Canebrake Canyon	Yuma	Limitrophe	Total
CW I		32					36
CW II	26		116	9		34	151
CWIII	644	335	75	316	318		1833
CW IV	117		239	145	258	145	928
CW V	62		16	30	6	169	152
SC III				20		38	31
SC IV	5321	11	292	3275	438	11	9567
MA 2	275			115	12	230	402
MA 3				230			230
MA 4	815		125	936	27		1930
TOTAL	7260	378	863	5076	1059	627	15290

ally referred to as the Imperial Division. Both areas are mainly under federal ownership. The potential habitat outside of these two areas usually occurs on national wildlife refuges. Very little occupied or suitable but currently unoccupied habitat is privately owned along the lower Colorado River.

RESTORATION AND ACQUISITION OF BREEDING HABITAT

RPA#11 states "...Reclamation shall present a plan to the MSCP for funding and implemtation of the long-term program, e.g., through acquisition, easements, partnerships, ecological restoration, etc., with the goal of initiating implementation by May 15, 2001. Alternative off-site compensation approaches that may be developed through the MSCP, that are aimed at achieving the same goals, could satisfy this provision" (USFWS, 1997). In order to expedite this process, this report lists potential areas along the lower Colorado River (Figure 19) and elsewhere within the range of the southwestern willow flycatcher where restoration, protection, and acquisition of flycatcher breeding habitat may be accomplished. Reclamation has contracted The Nature Conservancy (TNC) to analyze potential off-site areas where protection measures, such as habitat acquisition or conservation easements, could be obtained to further benefit the southwestern willow flycatcher. The initial draft report focused on the highest priority sites within the range of the flycatcher and is included in this report. The final TNC report is due July 1, 1999.

Lower Colorado River

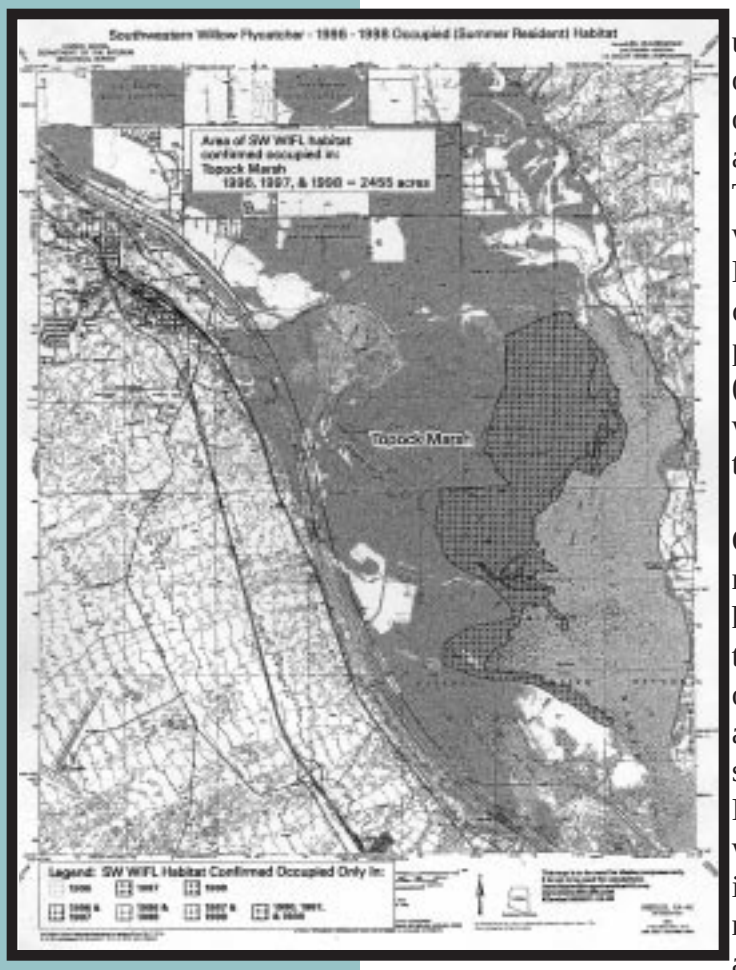


Figure 18. Occupied habitat at Topock marsh near Needles, California.

The majority of the occupied and suitable but unoccupied habitat is currently under federal ownership. The one remaining large block of occupied habitat not under federal control is an approximately 600 acre patch on the west side of Topock Marsh, near Needles, California, that is within the reservation boundaries of the Fort Mojave Tribe. This block of occupied habitat is contiguous with an additional 1900 acres of occupied habitat on Havasu National Wildlife Refuge (Figure 18). Reclamation is currently negotiating with the tribe to secure a long-term lease to protect this important habitat.

Opportunities exist for restoration and enhancement of southwestern willow flycatcher breeding habitat along the lower Colorado River. Most of these opportunities require intensive management of the resource. Riparian restoration projects along the lower Colorado have met with limited success in the past (Pinckney, 1992; Briggs, 1992; Briggs and Cornelius, 1997). Water availability, water table fluctuation, and soil salinity have been identified as large obstacles that must be incorporated into any riparian restoration project plan along the lower Colorado River. Recent studies have indicated that soil salinity may be increasing in many areas of the Colorado River (USBR, 1998). Restoration projects for willow flycatchers present several additional concerns. Riparian vegetation should be grown in dense patches and water must be present near or within the stand to simulate flycatcher habitat. Other factors not presently known or understood may also have to be incorporated into future restoration projects. Non-biological roadblocks must also be overcome such as acquisition of water rights, funding, and political concerns over acquisition of private lands.

Opportunities within the Yuma Valley

Although the Yuma Valley has undergone extensive man-cause changes since the turn of the century, some of the best opportunities for restoration and enhancement of flycatcher habitat exist there. The Limitrophe Division, which extends from the Northerly International Boundary above Morelos Dam to the Southerly International Boundary, contains occupied habitat near Gadsden, Arizona. A series of backwater areas, surrounded by dense willow and saltcedar, at Gadsden Bend and at Hunter's Hole have been identified as

occupied and suitable but unoccupied habitat. More potential habitat exists just below Morales Dam on the Cocopah Reservation.

In order to maintain existing habitat and enhance other portions of the Limitrophe, water is needed. The existing riparian vegetation is a result of the winter flood of 1992-93. Periodic flood control releases have enabled this habitat to survive since the 93 flood. To maintain and enhance this area, some flow must be allowed to pass Morelos periodically or an alternative, such as pumping agricultural waste water directly into the suitable habitat, must be arranged. The former alternative would enable large-scale natural restoration to occur if annual releases were allowed to flow past Morelos Dam. The latter alternative would allow for the maintenance of existing habitat and, with adequate agricultural return flow, the restoration of limited areas along the US side of the river.

The Limitrophe Division also has some limited opportunities for more intensively managed restoration activities adjacent to the existing floodplain. The Bureau of Land Management has several agricultural leases in this area, totaling approximately 660 acres (Dave Smith, per. comm.). These fields have been under cultivation for years, which indicates a high probability that the soils are suitable for restoration of native vegetation, and have intact water delivery systems. Artificial seeding or planting of native riparian species could provide additional blocks of habitat.

In 1938, the Limitrophe Division had an estimated 3800 acres of willow flycatcher habitat present within the restricted floodplain boundary. In 1994, there was approximately 667 acres of occupied and suitable but unoccupied habitat present. While intensive water management may not be able to fully reproduce 3800 acres of willow flycatcher habitat, it is not without reason to speculate that 1500-2000 acres could be reproduced and maintained within this reach if water was allowed to flow past Morelos Dam. At a minimum, 700 acres could be maintained and enhanced through management of agricultural return flows.

The Limitrophe Division presents a lot of challenges as well as opportunities. While the east side of the Colorado River lies within the United States, the west side is Mexican territory. Consequently, any large-scale restoration activities within the floodplain should be done with approval from Mexico. Mexican concerns with water quality issues also needs to be addressed, especially if agricultural return flows are utilized in any floodplain restoration. Protection measures within the Limitrophe will be hard to enforce due to the proximity of Yuma, Arizona. Access closures will be difficult to enforce. Man-caused wildfire will be a constant threat. Channel capacity within the Limitrophe is of major concern to the metropolitan Yuma area. Increasing riparian habitat without maintaining the ability to convey flood flows could increase the potential for major flood events within the City of Yuma.

The second major stretch of the Colorado River, within the Yuma Valley, which presents large-scale restoration potential is the area between the confluence of the Gila River and Prison Hill. The Gila River flood of 1992-93 naturally reproduced over 300 acres of cottonwood-willow habitat around the confluence. Additional restoration activities have been conducted in this area by Reclamation on a small-scale. Intensive management, such as dredging channels throughout the area, coupled with the proper water management, could create additional habitat within this area.

As with the Limitrophe, the area around the confluence will require active management to provide protection for existing and potential habitat. The Colorado River below the confluence is restricted by levees that protect the City of Yuma, the Quechan Tribal Reservation, and surrounding agricultural lands. Any restoration activity must be accomplished in such a way as to not lessen the effectiveness of these flood control structures. Any activities must be restricted within the present floodplain unless a totally artificial restoration project is attempted on adjacent farm lands. Restoration projects outside of the floodplain would require planting and watering the site (i.e. creating a willow "farm") to such a degree as to make all but the smallest project to expensive to accomplish. Access closure in the area around the confluence would be impossible to achieve, thus increasing the risk of man-caused fire.

The remainder of the Yuma Valley offers limited opportunity for large-scale restoration. The Yuma Division, between Laguna Dam and the confluence of the Colorado and Gila Rivers, does not have an armored bank line, however, only large flood events have effected this area. Any event large enough to produce riparian habitat to the extent needed by willow flycatchers would have an adverse effect on the City of Yuma and the surrounding area so artificially creating such an event would not be practical.

Opportunities from the head of Canebrake Canyon to Laguna Dam

The amount of habitat suitable for breeding southwestern willow flycatchers has increased from Canebrake Canyon to Laguna Dam since historical times. Occupied and suitable but unoccupied habitat exists from the head of Canebrake Canyon, near Walker Lake, to Imperial Dam. Opportunities for creating more habitat exist on Imperial National Wildlife Refuge, north of Martinez Lake. Currently, Imperial National Wildlife Refuge, Reclamation, and Ducks Unlimited are cooperating in an effort to create a floodplain restoration demonstration on the refuge as part of RPA#14. The data collected during this study may help future efforts in large-scale restoration of riparian habitat. The Fish and Wildlife Service and Reclamation have also established a native plant nursery and have conducted several native riparian vegetation planting demonstrations at Imperial Refuge. There are other opportunities within Imperial Refuge, especially along the northern shore of Martinez Lake, for future riparian restoration projects.

The second area, within this stretch of the river, that has restoration potential is area that lies between Imperial Dam and Laguna Dam. Reclamation has proposed a large-scale restoration project within this area that would benefit many species, including the southwestern willow flycatcher. The proposed project would entail installing an outlet structure along the main river channel, just below Imperial Dam, at a junction with an old river meander that has become overgrown with saltcedar. The old meander would then be dredged, providing a source of water to the east side of the area. Other proposed projects within this area include the creation of a RPA#14 demonstration site on a recently farmed, former BLM agricultural lease in the Mittry Lake-Betty's Kitchen area above Laguna Dam.

Opportunities within the "Great Valley"

Historically, the Great Valley (the area between Parker, Arizona, and the head of Canebrake Canyon) contained approximately half of all the willow flycatcher habitat present between the Grand Canyon and Mexico. Agricultural development, river channelization, and bank line stabilization have eliminated almost all of the historical habitat. Occupied and suitable but unoccupied habitat is limited to a few areas around backwater lakes, mostly on federally managed lands. Opportunities for large-scale restoration projects are limited as well. Soil salinity and depth to ground water are constant problems throughout the Great Valley.

Cibola National Wildlife Refuge has some limited areas where potential restoration projects might be undertaken. Currently, The Fish and Wildlife Service, Reclamation, and Ducks Unlimited have partnered to rehabilitate an old river meander on the Island Unit of Cibola Refuge as part of RPA#14. Data gathered in this study will be used to help determine possible new restoration techniques for large-scale restoration activities. Several additional areas within the refuge have potential. Hart Mine Marsh, on the Arizona side of the river east of the Cibola Dry Cut, has potential to be rehabilitated as both flycatcher habitat and, possibly, razorback sucker habitat. The areas between the river and the levee along both banks of the Dry Cut within the refuge boundaries could become a potential restoration area by either breaching the armored bank line of the river or by removing enough soil to get the soil surface within 3-4 feet of the river elevation and placing conduits between the river and these newly scoured areas so that periodic managed flood events could occur within these areas. Another source of potential restoration projects are to rehabilitate old or currently used agricultural areas within the refuge boundary, such as the farm fields due west of the refuge headquarters.

A list of other potential restoration sites within the Great Valley is somewhat limited. There is a 3500 acre block of agricultural land adjacent to Cibola

Refuge to the north that has been included in a proposed land exchange with the federal government. Most of this land has been under agriculture for many years and may be suitable for riparian restoration. However, the depth to groundwater in this area makes active management of any restoration project essential so water rights must be included with any purchase or exchange of this land. A second area of approximately 180 acres on Cibola Island, just to the west of the proposed exchange lands, may be for sale. This area, like the exchange lands, has been under agriculture for many years and should be suitable for restoration of native riparian species. Again, active management will be required at this site as the depth to groundwater averages around 12 feet. On the east side of the river, below the I-10 bridge at Blythe, there is some potential to restore and enhance habitat near the occupied site below Ehrenberg, Arizona. As with the river side areas at Cibola Refuge, this restoration would require removal of the stabilized bank line or a large-scale construction operation, including soil removal and placement of culverts to transport water from the river, through the levee, to the site.

At the south end of the valley, between Cibola National Wildlife Refuge and BLM land near Walker Lake, is a small parcel of privately owned land with occupied habitat. This land is presently owned by Catellus Corporation and has been recently included as part of a potential land exchange between Catellus and the Federal government. The land exchange is on hold and may not occur due to other mitigating factors. If the exchange does not go through, Catellus may be amenable to an outright purchase of this property. The Gilmore's Camp property, as it is known, contains approximately 115 acres of occupied habitat.

At the north end of the Great Valley, lies the Colorado River Indian Tribal Reservation (CRIT). The CRIT have been actively conducting restoration projects within the past five years. Currently, the CRIT, Reclamation, Ducks Unlimited, and the MSCP have entered into a cooperative project to restore the Deer Island backwater system within the Ahakah Tribal Preserve. Future restoration projects may be conducted along that stretch of the river.

Other potential restoration projects within the Great Valley would require retiring BLM agricultural leases or the outright purchase of privately owned agricultural lands within the valley. The viability of any potential project would have to evaluated on a case by case basis. Most, if not all, restoration projects on former or current agricultural lands would require water rights to effectively manage these areas for willow flycatcher.

Opportunities within the Chemehuevis Valley and along the lower Bill Williams River

Chemehuevis Valley now lies under Lake Havasu. The shoreline of Lake Havasu is not conducive to native riparian restoration as the majority of the shoreline is creosote desert. The Parker Strip, between Parker Arizona and

Parker Dam, also has little to no potential for riparian restoration.

The only area within this portion of the river that could be considered for potential restoration activities is the lower Bill Williams River. The majority of the lower Bill Williams River floodplain is comprised of lands within the Bill Williams River National Wildlife Refuge. The Bill Williams Refuge contains the last of the large cottonwood-willow gallery forests along the lower Colorado River. Approximately 806 acres of the Bill Williams Refuge is considered to be occupied habitat. In 1990, a wildfire burned approximately 500 acres of cottonwood-willow forest at the forest-marsh interface. Since that time, most of this area has regenerated with saltcedar. The potential to restore habitat within the old burn area is good as the Fish and Wildlife Service and the Corps of Engineers have reached an agreement on regulating water flow down the Bill Williams from Alamo Dam. Several other sites (old fields on the north side of the river) on the refuge have potential for restoration as well.

One additional area along the lower Bill Williams River has great restoration potential. Planet Ranch is located adjacent to the refuge on the upstream side. Planet Ranch is owned by the City of Scottsdale, Arizona. Scottsdale would like to sell the ranch and has entertained offers in the past. Planet Ranch is approximately 8,400 acres, of which 2,300 acres are located within the floodplain of the Bill Williams River. Most of the 2,300 acres within the bottom lands have been irrigated in the past and are suitable for riparian restoration. Planet Ranch would also come with water rights so that active management would be possible. Access to this area is difficult and could be limited very easily. An old county road runs along the Bill Williams from Arizona Highway 95 until a point within the refuge that was washed out in the 1993 flood. This roadcould be improved and gated to allow access for fire vehicles while limiting public access. Scottsdale purchased Planet Ranch for approximately 8 million dollars in 1984 and has asked for 15 million dollars. The asking price is well above the most recent government appraisal making purchase by the federal government unlikely.

Opportunities within Mohave Valley

Restoration opportunities within the Mohave Valley are limited to Havasu National Wildlife Refuge and, possibly, on Fort Mojave Tribal lands. Topock Marsh, where the largest contiguous block of occupied southwestern willow flycatcher habitat can be found, lies within the boundaries of Havasu National Wildlife Refuge. The occupied habitat extends from the north end of the marsh south along three quarters of the marsh. The southern end of the marsh, near Beal Lake, has potential to become flycatcher habitat as well. In 1998, a wildfire burned 2500 acres just west of the occupied habitat. Unfortunately, little water exists within the burned area to create willow flycatcher habitat although the potential does exist on the southeast portion of the burn area from Glory Hole to Beal Lake. Approximately 500 acres of occupied habitat within the refuge were burned and could be replaced. The

Fish and Wildlife Service has written a fire rehabilitation plan for this area. Several other possibilities exist near Pintail Slough, at the north end of Topock Marsh.

Lower Gila River

The lower Gila River, between Wellton, Arizona and the confluence of the Gila and Colorado Rivers, offers several opportunities for large-scale restoration and enhancement activities. The 1992-93 Gila flood regenerated several thousand acres of new cottonwood-willow stands in the Welton area and the area between the Arizona Route 95 bridge to the confluence. Reclamation is currently under negotiation with the Wellton-Mohawk Irrigation District to enter into a land exchange that would give Reclamation control over more than one thousand acres along the Gila River in the Antelope Hill area, near Wellton. Many of these acres have newly established willow stands where migrant willow flycatchers have been observed. The potential for restoration and enhancement of willow flycatcher habitat here is extremely good.

The area near the confluence of the Gila and Colorado also had good regeneration of cottonwood and willow during the 1992-93 flood. Most of this area is privately owned and several landowners have expressed interest in selling these bottom lands. Water rights need to be included in any land purchase in this area as the Gila River is normally dry for long periods of time within this stretch of the river.

INSERT TNC REPORT

SUMMARY

This report has been submitted to the MSCP in accordance to RPA#11 of the BO on Reclamation's routine operation and maintenance of the lower Colorado River (USFWS, 1997). RPA#11 directs Reclamation to submit a plan to the MSCP for funding and implementation of a long-term program to restore, enhance, and protect southwestern willow flycatcher breeding habitat along the lower Colorado River. In order to determine the amount of habitat needed for compliance of RPA#11, an estimate of historical habitat was necessary. An analysis of 1938 aerial photography, historical journals, historical photographs, surveyor plats, and historical maps indicated approximately 89,200 acres of potential suitable willow flycatcher breeding habitat between the Grand Canyon and the Southerly International Boundary between the US and Mexico. This estimate is a "snapshot in time" and must be placed in context with the natural flood cycles and human-caused disturbances along the lower Colorado River at this time. Analysis of these other factors indicates that 89,200 acres was, in all likelihood, at the high end of the natural range of potential habitat.

Southwestern willow flycatcher surveys, conducted by San Bernardino

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APPENDIX A

Reasonable and Prudent Alternative Provision Number 5 (USFWS, 1997)

Immediate habitat protection/restoration. Reclamation shall immediately initiate a program to protect approximately 1,400 ac (565 ha) of currently unprotected riparian habitat that is currently used by southwestern willow flycatchers, preferably in the LCR area, but if insufficient land is available, then elsewhere within the southwestern willow flycatcher's range. If insufficient seasonally occupied habitat can be identified to be in need of protection, then unoccupied, but high potential, habitat may be protected instead. All the required protections for at least 500 ac (202 ha) must be in place by January 1, 1999, and any necessary ecological restoration of the newly protected sites, including, but not limited to, cottonwood/willow reforestation, must be initiated by that date; all the required protections for the remaining areas necessary to comprise 1,400 ac total must be in place by January 1, 2001, and any necessary ecological restoration of the additional newly protected sites must be initiated by that date.

Protection can occur through acquisition, easements, partnerships, ecological restoration, etc., that result in long-term preservation of the habitat from destruction and from alteration in ways that would decrease its value as flycatcher habitat. The order of priority shall be: 1) occupied habitat on the LCR, 2) occupied habitat elsewhere in the flycatcher's range, 3) unoccupied, potential habitat on the LCR, and 4) unoccupied, potential habitat elsewhere in the flycatcher's range. Reclamation shall immediately initiate a rangewide evaluation to identify suitable lands requiring protection for the recovery of the southwestern willow flycatcher (to be done in conjunction with the plan called for in the long-term flycatcher alternative compensation habitat provision, number 11, below).

Reasonable and Prudent Alternative Provision Number 11 (USFWS, 1997)

Alternative compensation habitat. Reclamation shall take part in a long-term program of on- and off-site compensation for historical southwestern willow flycatcher habitat that is lost and is not restorable on the LCR because of the effects of Reclamation's continuing operations and maintenance activities. This shall be coordinated with the rangewide evaluation called for in flycatcher short-term provision number 5, above, and with the Southwestern Willow Flycatcher Recovery Plan (in progress) and other efforts of the Southwestern Willow Flycatcher Recovery Team. The on-site compensation is additive to the requirements of provision number 5, above, and may be done in conjunction with provision number 14, below, on ecological restoration. The off-site compensation habitat, if not already used by southwestern willow flycatchers, will be managed to eliminate or sufficiently reduce the factors limiting to the species. By January 1, 1999, Reclamation shall present a plan to the MSCP for funding and implementation of the long-term program, e.g., through acquisition, easements, partnerships, ecological restoration, etc., with the goal of initiating implementation by May 15, 2001. Alternative off-site compensation approaches that may be developed through the MSCP, that are aimed at achieving the same goals, could satisfy this provision.

This compensation represents the amount of historical southwestern willow flycatcher habitat lost or precluded from developing into suitable flycatcher habitat due to inundation, lack of flooding, widely fluctuating water levels, exotic species encroachment, water quality, soil salinity, or permanent structures because of the continuing effects of Reclamation's facilities and operations. Criteria for suitable or potential flycatcher habitat are found in the Status of the Species—Habitat Use section of this BO. Reclamation, in conjunction with flycatcher short-term provision number 5, above, on immediate habitat protection, shall immediately initiate a rangewide evaluation to identify suitable lands requiring pro-

tection for the recovery of the flycatcher; this shall be coordinated with other flycatcher recovery efforts undertaken in the future by the Service, as well as with any flycatcher conservation efforts undertaken through the MSCP. As in provision number 5, protection can occur through acquisition, easements, partnerships, ecological restoration, etc., that result in long-term preservation of the habitat from destruction and from alteration in ways that would decrease its value as flycatcher habitat.